

**REMEDIAL ALTERNATIVES EVALUATION**

**HARDESTY FEDERAL COMPLEX  
601-607 HARDESTY AVENUE  
KANSAS CITY, MISSOURI**

**July 12, 2004**

**Burns & McDonnell Project No. 36204**

**Burns & McDonnell Engineering Company, Inc.  
Engineers-Geologists-Scientists  
Kansas City, Missouri**

## SUBMITTAL CERTIFICATION

Submittal Description: Remedial Alternatives Evaluation, Hardesty Federal Complex,  
601-607 Hardesty Avenue, Kansas City, Missouri

I certify that the above submittal was prepared under my supervision according to current geological practice, and that to the best of my knowledge it is complete and accurate.

Signed: Troy L. Cooley

Registration No.: RG 0419



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## 1.0 INTRODUCTION

### 1.1 GENERAL

This remedial alternatives evaluation is presented to address an area of chlorinated solvent groundwater contamination identified at the Hardesty Federal Complex (Site), located at 601-607 Hardesty Avenue in Kansas City, Missouri (see Figure 1). Numerous studies and investigation have been completed at the Site to identify and assess the extent of contamination resulting from historical Site activities. Information utilized to complete this evaluation was obtained from the following investigations completed at the Site:

- *General Services Administration (GSA) Preliminary Assessment* (Terracon, 2002a),
- *GSA Site Inspection* (Terracon, 2002b),
- *On-Site Groundwater Investigation Report* (Terracon, 2003a),
- *Off-Site Groundwater Investigation Report* (Terracon, 2003b),
- *Remedial Alternatives Evaluation* (Terracon, 2003c).
- *Off-Site Groundwater Investigation Report* (Burns & McDonnell, 2004).

The risk evaluation provided in the Burns & McDonnell's *Off-Site Groundwater Investigation Report* (Burns & McDonnell, 2004) indicates that off-site groundwater contamination is unlikely to present a health hazard to the surrounding populations and environment. In addition, soil samples collected during previous on-site investigations did not indicate VOC concentrations above the MDNR CALM Soil Target Concentrations (STARC) and Leaching to Groundwater Values. Therefore, this remedial evaluation will address on-site groundwater contamination only.

### 1.2 SITE HISTORY

The Hardesty Federal Complex, presently owned by GSA, comprises a total area of approximately 18 acres. Seven buildings, numbered 3, 6, 7, 8, 10, 11, and 13, are currently located on the Site. All of the buildings are currently empty.

According to previous investigations, groundwater contamination has been identified within the vicinity of Building 6. Building 6 was originally constructed as a clothing treatment / renovation plant, operated by the Chemical Warfare Service. Processes conducted at Building 6 included the treatment / renovation of new Army uniforms with "Impregnate I" to make them gas-resistant against chemicals such as

“mustard gas”, and the laundering of old uniforms. Each process may have used dry-cleaning agents. A cooling tower, two pump houses, two storage tanks, and a recovery tank used to operate the clothing treatment plant were formerly located south of Building 6. Previous reports have also indicated that two concrete pits each containing several concrete tank supports were located south of Building 6. These pits have been demolished and filled with sand and soil.

The volatile organic compounds (VOCs) 1,1 Dichloroethene, 1,1,2,2-perchloroethane (PCA), perchloroethene (PCE), 1,1,2-trichloroethane (TCA), trichloroethene (TCE), and vinyl chloride have been detected in groundwater above the MDNR CALM GTARC levels at the Site, with PCA and TCE being the two constituents detected most frequently. The highest area of VOC groundwater contamination at the Hardesty Federal Center was identified beneath the grassy area south of Building 6. This source of VOC contamination in this area may be associated with the clothing treatment / renovation plant. VOC contaminants such as PCA, PCE, TCA, TCE, and cis-1,2-dichloroethene (cis-1,2-DCE) can be typically be associated with the use of dry-cleaning agents. Above ground storage tanks used for storage of virgin processed dry-cleaning type solvents were historically located outside the west end of Building 6.

The chlorinated solvents detected at the Site are dense nonaqueous phase liquids (DNAPLs). These DNAPLs have a higher density than water and will tend to sink through the aquifer over time as well as spread horizontally. The apparent degradation pathway for the chlorinated solvents identified at the Site is: PCA (and possibly PCE) → TCE/TCA → cis/trans 1,2-DCE → vinyl chloride. Groundwater at the Site appears to flow in an east / northeast direction.

### **1.3 REMEDIAL OBJECTIVE**

The remedial objective for the Site is to reduce on-site groundwater contaminant concentrations to minimize future off-site migration. Meeting this remedial objective was emphasized during the evaluation of remedial alternatives.

It is important to note that the remedial objective is not to reduce all contaminants to non detect levels, but to provide contaminant reduction to levels that are protective of human health and the environment.

#### **1.4 EXTENT OF ON-SITE CONTAMINATION**

The general extent of groundwater contamination identified at the Site is shown on Figure 2. As indicated in Figure 2, the groundwater contamination is relatively widespread (approximately 250,000 square feet) across the northeast portion of the Site. The depths of the on-site VOC groundwater plume were found to be at depths ranging from 12.91 feet to 83.60 feet below ground surface, with TCE being the primary Site contaminant. The potential source area, where groundwater contaminant concentrations are highest, is located south and east of Building 6. This area is also indicated on Figure 2.

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## **2.0 REMEDIAL OPTIONS**

### **2.1 GENERAL**

As indicated in the *Remedial Alternatives Evaluation* (Terracon, 2003c), Terracon has recommended enhanced natural attenuation and monitoring as the remedial alternative for the Site. Enhanced natural attenuation is a viable option for treatment of the entire groundwater contaminant plume identified on-site. However, Burns & McDonnell would like to present an alternate remedial approach, utilizing chemical oxidation to target the areas of highest concentration of on-site groundwater contamination. Utilizing chemical oxidation to target the areas with the highest identified concentrations will offer a significant reduction in remedial cost, while still providing a reduction of on-site contaminant concentrations to levels protective of human health and environment. A review of the two technologies is provided in the following sections.

One item not completely defined in the *Remedial Alternatives Evaluation* (Terracon, 2003c) was the injection method. The main challenge with implementing remedial alternatives, such as enhanced natural attenuation and chemical oxidation, is providing sufficient chemical delivery to the contaminant areas. According to previous investigations, low permeable conditions exist on-site which may limit chemical injection effectiveness. In order to promote adequate chemical delivery across target areas, hydraulic fracturing is recommended during the application of either remedial alternative. Hydraulic fracturing involves the use of high pressure injection of air or water into the subsurface to open pathways for sufficient chemical delivery. This technique has been proven successful in promoting uniform distribution of chemical to target areas within low permeability zones.

### **2.2 ENHANCED NATURAL ATTENUATION**

Natural attenuation is a remedial option which provides a reduction in contaminant concentrations through biodegradation processes naturally occurring within the subsurface. Chlorinated solvents, such as those present within groundwater at the Site, have been proven to biodegrade under anaerobic conditions. Natural attenuation processes can be accelerated by supplying additional hydrogen to the subsurface, promoting rapid biodegradation of chlorinated solvent. This process, defined as enhanced natural attenuation, is conducted by injecting a hydrogen donor compound (e.g., lactic acid) into target areas of the subsurface using direct-push equipment.

### **2.2.1 Preliminary Approach**

Burns & McDonnell agrees with the general approach for application of enhanced natural attenuation as a remedial option if treatment of the entire site wide groundwater contamination is required. As indicated in the *Remedial Alternatives Evaluation* (Terracon, 2003c), enhanced natural attenuation would be conducted by injecting approximately 50,000 pounds of hydrogen donor compound (e.g., lactic acid) into the target areas using direct-push equipment. Injection would occur at approximately 270 locations (150 points to 60 foot depths within the source area on 10-foot centers, and 120 points to 60-foot depths in a down-gradient direction on 20-foot centers) to enhance the natural attenuation of the chlorinated solvents in groundwater. Hydraulic fracturing would be conducted for each injection to ensure necessary delivery of the hydrogen donor compound. Subsequent injections may be needed depending on the effectiveness of the initial application. An estimated 50 working days would be required to complete injection activities.

#### Treatability Study

Prior to the application of the chemical oxidation process, a treatability study would be performed using soil and groundwater samples collected from the Site. The purpose of the treatability study would be to determine the viability and effectiveness of the technology based on Site conditions along with quantifying the amount of hydrogen donor compound required for application.

#### Monitoring Program

Subsequent to the hydrogen donor compound injection, a monitoring program would be implemented to evaluate the effectiveness of the remedial alternative. As part of the monitoring program, six additional wells would be installed in up-gradient, cross-gradient, and down-gradient locations to assess degradation of the chlorinated solvents. These six wells along with the existing 10 on-site wells would be utilized for the monitoring program. Quarterly groundwater sampling would be conducted for the first year following injection. Semiannual sampling would then be conducted for the four years thereafter. Groundwater samples would be collected for VOCs and field parameters to evaluate natural attenuation.

### **2.2.2 Advantages**

The major advantage of the enhanced natural attenuation approach is that it is a proven technology which requires no long-term operation and maintenance. Additionally, because excavation is not required there will be a limited quantity of hazardous waste produced thus minimizing disposal of potentially

contaminated soil. In addition, the enhanced natural attenuation approach, as detailed in this evaluation, would provide treatment for the entire on-site groundwater contaminant plume.

### **2.2.3 Disadvantages**

The main disadvantages of enhanced natural attenuation are the relatively high costs for implementation and the difficulty to apply in low-permeability soils such as those underlying the Site. These difficulties may lead to non-uniform distribution of the hydrogen donor compound that may limit contaminant removal results. Hydraulic fracturing during injection would be conducted to promote uniform distribution, however, additional treatments may be required to achieve desired results.

Another disadvantage of enhanced natural attenuation is the amount of time required to reduce contaminant levels. Significant time may be required to allow the natural attenuation processes to provide significant contaminant reduction.

Before proceeding with implementation of this technology, a treatability study will be necessary to determine the effectiveness of this technology at the Site.

## **2.3 CHEMICAL OXIDATION**

Chemical oxidation is conducted by injecting chemical oxidants, such as hydrogen peroxide ( $H_2O_2$ ) or potassium permanganate ( $KMnO_4$ ), into the subsurface to oxidize contaminants. The oxidants attack the carbon bonds of the chlorinated solvent reducing the contaminant to non-toxic compounds such as carbon dioxide and water.

### **2.3.1 Preliminary Approach**

Burns & McDonnell would like to present a more targeted remedial approach, utilizing chemical oxidation to treat the area of highest concentrations of chlorinated solvent contamination. This area has been identified based on information gathered during previous investigations. The targeted area, approximately 14,000 square feet in size, is located south and east of building 6, as indicated on Figure 2. Treating the areas with the highest identified contaminant concentrations will remove the potential source of future down gradient contamination migration. Limiting future contaminant migration will also allow remaining on-site groundwater contamination to naturally attenuate without the influence of additional contamination.

The proposed chemical oxidant, potassium permanganate, would be injecting into the groundwater at approximately 35 on-site locations to promote chemical oxidation of the chlorinated solvents within the potential source area. Each location will be spaced on 20 foot centers and completed to a depth of approximately 60 feet. Three separate injections, utilizing hydraulic fracturing, will be completed with depth each location, to ensure sufficient oxidant application with depth across the contaminant plume. Approximately 105,000 pounds of oxidant would be injected (1000 pounds per injection) into the target areas using direct-push equipment. An estimated 20 days would be required to complete the injection activities.

#### Additional Groundwater Sampling

Additional groundwater sampling may be required to further define the area of highest contaminant concentrations. Further identifying the limits of the injection area will help design a more targeted approach thus increasing the effectiveness of groundwater treatment.

#### Treatability Study

Prior to the application of the chemical oxidation process, a treatability study would be performed using soil and groundwater samples collected from the Site. The purpose of the treatability study would be to determine the contaminant degradation kinetics and natural demand for the oxidant due to existing organic material in the soil. Results of the treatability study would be used to determine the amount of oxidant needed, and to finalize the design of the application process.

#### Monitoring Program

Subsequent to the chemical oxidant injection, a monitoring program would be implemented to evaluate the effectiveness of the remedial alternative. As part of the monitoring program, six additional wells would be installed in up-gradient, cross-gradient, and down-gradient locations to assess oxidation of the chlorinated solvents. These six wells along with the existing 10 on-site wells would be utilized for the monitoring program. Quarterly groundwater sampling would be conducted for the first year following injection. Semiannual sampling would then be conducted for the four years thereafter. Groundwater samples would be collected for VOCs and field parameters to evaluate the effects of the oxidation. Additional parameters could also be collected to evaluate natural attenuation across the Site.

### **2.3.2 Advantages**

The major advantage of chemical oxidation is that the effect of the remedy is almost immediate, and there is no long-term operation and maintenance required. Treatment of the area with highest contaminant concentrations will minimize any additional off-site migration of contaminated groundwater, and will address the remedial objectives for the Site. In addition, the oxidant applied within the injection area may have some beneficial impact on other on-site areas of contamination due to downgradient migration of the oxidants.

Another advantage of this technology at this Site is that it has a lower overall cost due to targeting the areas with the highest identified contaminant concentrations only and not the entire contaminant plume. It is important to note that groundwater beneath the Site is not currently utilized as a drinking water source. In addition, on-site contaminant levels in groundwater (as indicated in previous investigations) are well below the risk based levels established in the Off-Site Groundwater Investigation Report (Burns & McDonnell, 2004).

Finally, excavation is not required with this technology which will result in a low quantity of hazardous waste produced thus minimizing disposal of potentially contaminated excavated soil.

### **2.3.3 Disadvantages**

The main disadvantage of chemical oxidation is that it can be difficult to apply in low-permeability soils such as those underlying the Site. These difficulties may lead to non-uniform distribution of the oxidant that may limit contaminant removal results. Hydraulic fracturing during injection would be conducted to promote uniform distribution, however, additional treatments may be required to achieve desired results.

Additional sampling may be required to further define the source area of groundwater contamination.

Before proceeding with implementation of this technology, a treatability study will be necessary to determine the effectiveness of this technology at the Site.

## 2.4 REMEDIAL ALTERNATIVES COST ESTIMATES

Estimated costs associated with each alternative are provided in Table 1. Costs for each alternative were determined based on a preliminary approach using site-specific information. However, the costs presented are estimates, and are intended for comparison purposes only.

Costs are indicative of alternatives as conducted by Burns & McDonnell and do not reflect costs provided in the *Remedial Alternatives Evaluation* (Terracon, 2003c).

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### 3.0 RECOMMENDATIONS

Chemical oxidation is the remedial alternative recommended for the Site. Targeting the areas with the highest identified concentrations provides a significant reduction in remedial cost, while still providing a reduction of on-site contaminant concentrations to levels protective of human health and environment.

It is important to consider that groundwater beneath the Site is not currently used as a drinking water source and that groundwater contaminant levels, as identified in previous investigations, as well below the risk based levels established during Burns & McDonnell's *Off-Site Groundwater Investigation Report* (Burns & McDonnell, 2004).

Additional injections could also be implemented in the future to address "hot spot" areas to further reduce on-site contamination.

\* \* \* \* \*

## 4.0 REFERENCES

- Burns & McDonnell, 2004, *Off-Site Groundwater Investigation Report, Hardesty Federal Complex, 601-607 Hardesty Avenue, Kansas City, Kansas*, July 8, 2004.
- Missouri Department of Natural Resources (MDNR), 2001, *MDNR Cleanup Levels for Missouri (CALM) Groundwater Target Concentrations (GTARC)*, September 1, 2001.
- Terracon, 2002a, *GSA Preliminary Assessment Report, Hardesty Federal Complex, 601-607 Hardesty Avenue, Kansas City, Missouri*, November 4, 2002.
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- Terracon, 2003a, *Off-Site Groundwater Investigation Report, Hardesty Federal Complex, 601-607 Hardesty Avenue, Kansas City, Missouri*, September 9, 2003.
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- Terracon, 2003c, *Remedial Alternatives Evaluation, Hardesty Federal Complex, 601-607 Hardesty Avenue, Kansas City, Missouri*, October 30, 2003.
- USEPA, 1998, *Field Applications of In Situ Remediation Technologies: Chemical Oxidation*, EPA/542/R-98/008, September.
- USEPA, 2002, *Region IX Preliminary Remediation Goals (PRGs)*. 1 October.

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**TABLE**

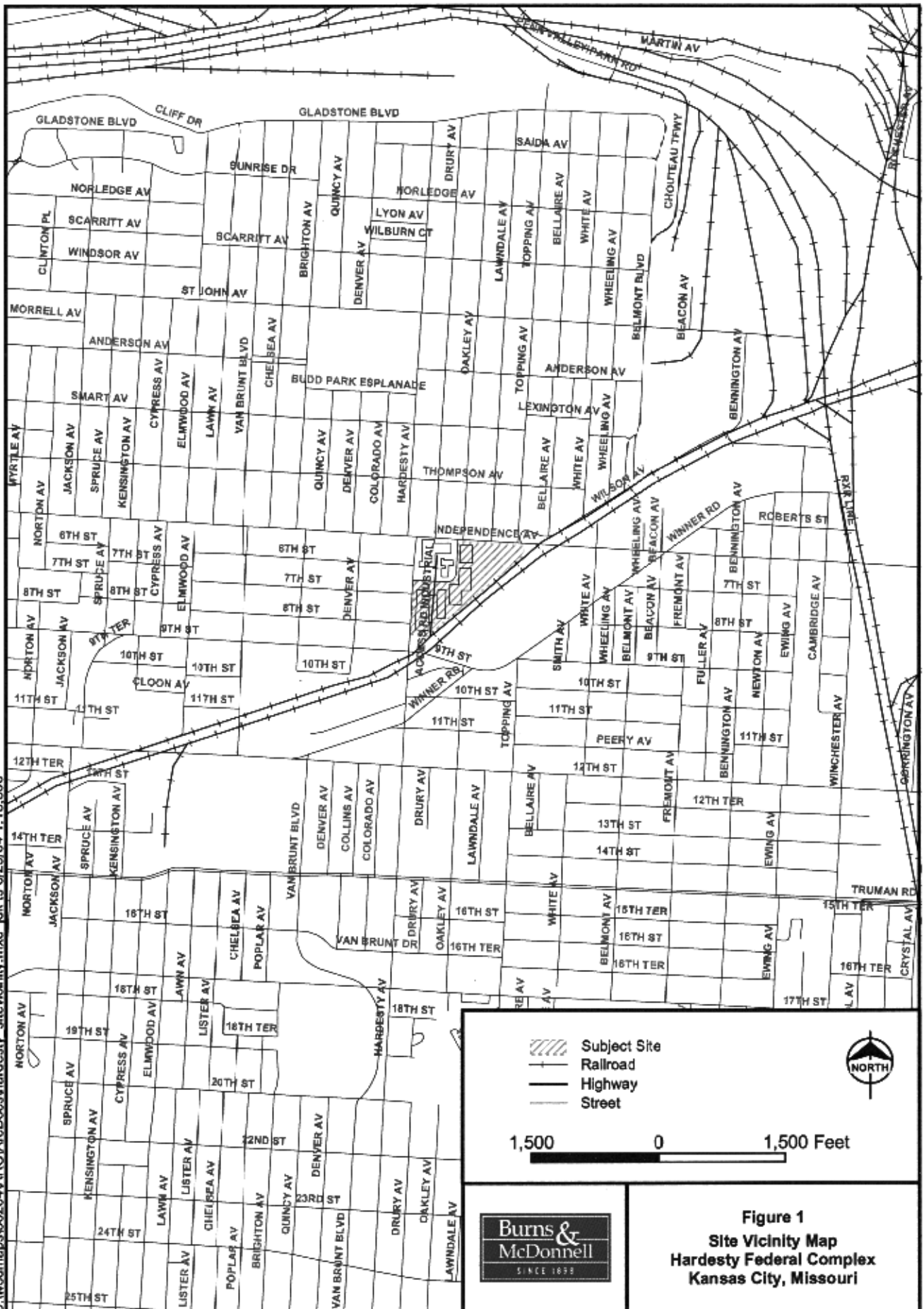
**Table 1**  
**Remedial Alternatives Cost Estimate**  
**Hardesty Federal Complex**  
**Kansas City, Missouri**

<b>Enhanced Natural Attenuation</b>	<b>Cost</b>
Submittal of required documents - includes Work Plan, Health and Safety Plan, Treatability Study, and required injection permit fees	\$50,000
Hydrogen Donor Compound - chemical costs only (assumes one application only)	\$75,000
Hydrogen Donor Compound Injection Costs - direct-push subcontractor utilizing hydraulic fracturing, including Burns & McDonnell oversight	\$1,400,000
Monitoring Well Installation - assumes 6 additional monitoring wells, including Burns & McDonnell oversight	\$50,000
First Year Monitoring Program - assumes quarterly monitoring and reporting	\$100,000
Four Year Monitoring Program - assumes semiannual monitoring and reporting	\$200,000
<b>Estimate Total for Enhanced Natural Attenuation</b>	<b>\$1,875,000</b>
<b>Chemical Oxidation</b>	
Submittal of required documents - includes Work Plan, Health and Safety Plan, Treatability Study, and required injection permit fees	\$50,000
Oxidant (Potassium Permanganate) - chemical costs only (assumes one application only)	\$160,000
Oxidant Injection Costs - direct-push subcontractor, utilizing hydraulic fracturing, including Burns & McDonnell oversight	\$335,000
Monitoring Well Installation - assumes 6 additional monitoring wells, including Burns & McDonnell oversight	\$50,000
First Year Monitoring Program - assumes quarterly monitoring and reporting.	\$100,000
Four Year Monitoring Program - assumes semiannual monitoring and reporting	\$200,000
<b>Estimate Total for Enhanced Natural Attenuation</b>	<b>\$895,000</b>

Note: Costs are estimated and are intended for comparison purposes only.

## FIGURES

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